

The Mississippian series was typically deposited not only along the line of the present Mississippi River, but off the shores and wholly surrounding the ancient Ozark Island. The deposition varied more or less off the different shores of the island, especially during the latter half of the period, when the body of land ceased to be entirely surrounded by water, by being partially or wholly joined to the mainland toward the north; the lower formations, however, included in the Kinderhook and Osage groups, may be expected to have a similar development on all sides of the ancient island.

CONCLUSION.

After a careful investigation of both the palæontologic and the stratigraphic evidence, it is believed that the position of the Batesville Sandstone is definitely established as the equivalent of the Aux Vases Sandstones of southern Illinois and south-eastern Missouri.

The paleontologic evidence also points to the equivalence of the Batesville Sandstone and the Maxville Limestone of Ohio, but in this case the evidence can not be strengthened by a comparison of the stratigraphy of the two regions involved.

WALKER MUSEUM, UNIVERSITY OF CHICAGO,
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NEW SPECIES AND A NEW GENUS OF AMERICAN PALEOZOIC FISHES, TOGETHER WITH NOTES ON THE GENERA ORACANTHUS, DACTYLODUS, POLYRHIZODUS, SANDALODUS, DELTODUS.

BY JOHN STRONG NEWBERRY.

[From a nearly completed MS. (1890-1891), edited by Bashford Dean.]

INTRODUCTION.

Professor Newberry was enabled to almost conclude his extended investigations upon the fossil fishes of North America by the publication of his monographs on the Palæozoic* and Triassic† fishes. During the last few years of his life he devoted almost his entire attention to the study of the plants of the

* Monograph XVI., U. S. Geol. Surv., 1889.

† Monograph XIV., U. S. Geol. Surv., 1888.

Cretaceous, and he was deeply engaged in the preparation of an extended work* on this subject at the time of his final illness.

The only MS. relating to fossil fishes which was found among his papers by Professor Kemp, his successor in the University, is the one which is now presented. This was probably written between the months of March, 1890, and June, 1891. The MS. was shown the present editor during the fall of 1892, on his return from abroad, but it was at that time his impression that the paper had been published. His unfortunate error in this regard was discovered only recently.

The MS. of the present paper proved in essential regards a complete one, as far, at all events, as the letterpress was concerned. It required but rearrangement and the insertion of references. The editor's greatest difficulty was encountered on the side of illustrations; the figures of a number of the species were lacking, and in nearly every case the drawings were detached and unaccompanied by definite labels. In the identification of these figures the greatest care became, therefore, necessary before the plates could be prepared. In two instances it was found best to omit the species entirely on account of this uncertainty. On the other hand two species have been defined in spite of the lack of figures, the characters given in the description appearing distinctive. The following figures are from drawings of Miss Mary A. Knight, Pl. XXII., figs. 4, 5; Pl. XXIII., figs. 1, 5-11; Pl. XXIV., figs. 12, 24-28. It should also be stated that the MS. contained the description of two species of *Ptycodus* then believed to be new, but now shown definitely, thanks to a fine series of these dental plates in Harvard Museum, to be but variational forms of *P. calceolatus*, N. & W. On this account these pages have been omitted. Of Pl. XXII., figs. 1, 2, 2a, 6 and of Pl. XXIII., 2, 3, 4 are by Mr. Arthur Hollick. The remainder are from photographs by the editor.

For information in this matter, as well as for other notes regarding questionable points in the paper, the editor has been greatly indebted to his friend, Dr. C. R. Eastman, of Harvard University. As far, however, as the personal views of Dr. Newberry were concerned, as for example regarding the separateness of the genera *Dactylodus* and *Deltodus*, the editor has been careful to insert every note that the MS has yielded—believing that the author's long experience with a vast material of these forms has given his views upon these points an especial weight.

* This monograph has recently been published (Washington, 1897), thanks to the care and labor which its editor, Mr. Arthur Hollick, has devoted to it.

The present paper includes descriptions of new species of palaeozoic fishes, together with critical notes upon several genera. These may be summarized as follows:

- Cladodus splendens*, n. s.
 " *mortifer*, n. s.
Oracanthus vetustus, Leidy, discussion of.
 " *pugniunculus*, St. J. & W., discussion of.
 " *lineatus*, n. s.
Ctenacanthus gurleyi, n. s. (Not figured.)
 " *depressus*, n. s.
Stethacanthus productus, n. s.
 " *compressus*, n. s.
Asteroptychius gracilis, n. s. (Not figured.)
Dactylodus princeps, N. & W., discussion of.
 " *latus*, n. s.
 " *rectus*, n. s.
Deltodus grandis, N. & W., discussion of.
 " *inornatus*, n. s.
 " *complanatus*, N. & W., discussion of.
 " *spatulatus*, N. & W.
Sandalodus ellipticus, n. s.
Psephodus (Helodus) politus, n. s.
Helodus coxanus, n. s.
Ctenodus fleisheri, n. s.
 " *angustus*, n. s.
Stenognathus corrugatus, n. g. (= *Dinichthys corrugatus*, N.)

CLADODUS SPLENDENS, Newb.

Pl. XXII., fig. 1.

Teeth of moderate or large size, robust, average specimen one and a half inches broad at base, one and a quarter inches high, central cone robust, ancipital, anterior surface highly polished, and splendid, lateral cones two on each side of nearly equal size, like the central cone tumid and highly polished, posterior surface of central and lateral cones faintly striated.

This splendid tooth has a marked resemblance to those of *C. elegans* of the St. Louis limestone and I should not hesitate to consider them identical, if it were not that in *C. elegans* the entire front and rear surfaces of the central and lateral cones are covered with strongly marked raised lines. In fact no other species with which I am familiar is more strongly striated; whereas in *C. splendens* the whole surface is smooth and brilliantly polished. The form of the teeth in the two species is, however, very similar, the lateral cones of *C. elegans*, two on each side, are relatively large and nearly equal as in *C. splendens*, but in the former species they are more divergent, less compressed and are strongly striated, while in *C. splendens* they are nearly erect and the surfaces are smooth and brilliantly polished.

The figure and description of *C. elegans* published in the fourth volume of the report of the Geological Survey of Illinois are wrong in representing the exterior lateral cones as much larger than the median. The specimen upon which the description was based was imperfectly preserved and abnormal. Better specimens recently received from Mr. McAdams, of Alton, Ill., show that the teeth are more robust, less compressed and have the lateral denticles more nearly equal in size than was the case in the type specimen.

Formation and locality, Kinderhook group, Burlington, Iowa. Type in the cabinet of Mr. William F. E. Gurley, of Danville, Ill.

CLADODUS MORTIFER, N. & W.

Pl. XXII., figs. 2, 2a.

In the second volume of the Geological Survey of Illinois were published a description and a figure of a very imperfect tooth which was taken as a type of this species. Since that time numerous specimens have been found in the Coal Measures of Illinois and Indiana and I am now able to give a figure of one of these which is practically complete and affords a far more satisfactory view of the species. The restored figure, 5, plate I. of the volume cited accurately represents the normal form, but the surface markings which are quite strong are not seen in it. Both the central and lateral cones are conspicuously striated and the former is much flattened and sharply double-edged so as to penetrate flesh with greater facility. The lateral cones are relatively large, the base broad and strong so that it has a decidedly bristling and hostile appearance. A diagnostic mark of the species is formed by two raised pads or cushions on the upper surface of the base; these are irregularly rounded, about a quarter of an inch in diameter, and are situated about opposite the internal pair of lateral cones.

The specimen now figured is from the Lower Coal Measures near Newport, Indiana.

GENUS ORACANTHUS, Agassiz.

ORACANTHUS VETUSTUS, Pl. XXII., fig 3.

In 1833 in his "Poissons Fossiles" Professor Louis Agassiz described and figured, under the name of *Oracanthus*, certain broad, compressed Elasmobranch spines found in the Carboniferous limestone of England and Ireland. Of these he formed four species, *O. Mulleri*, *O. minor*, *O. pustulosus* and *O. confluens*. Of these the first three were described, the last mentioned

only by name. Subsequent writers as Giebel, Bronn, McCoy, and Morris have enumerated or redescribed these species and have based upon irregular fragments of them descriptions of supposed species of *Cocosteus*, *Asterolepis* and *Platygnathus*. The spines of *Oracanthus* are generally broadly triangular, compressed, thin-walled, and the surface tuberculated; hence they were frequently found broken and the fragments were erroneously referred to other genera.

The bibliography of the genus has been recently worked out with much care by Mr. J. W. Davis in his "Fossil Fishes of the Carboniferous Limestone" (page 525) and he has given several striking figures which illustrate the protean forms and singular character of these spines, some of which were of enormous size. One specimen figured by Davis is eight inches broad at the base and must have been nearly a foot and a-half in length. Others are broad triangles, two or three inches in length and in breadth of base, very thin walled, mere shells in fact, which are much compressed, distorted and broken. Such differences have suggested to Mr. Davis that only a portion of these spines were dorsal and that others were set on different parts of the body, after the manner of the spines of *Climatius*.

In our own country the first species of *Oracanthus* was described by Professor Joseph Leidy in the Journal of the Academy of Natural Sciences of Philadelphia, Second Series, p. 161, pl. 16, figs. 1-3 (1856). The type specimen of the species, which he named *O. vetustus*, was obtained from some unknown locality in "Missouri Territory" and was supposed to be from the Carboniferous formation. It is about five inches in length, three inches broad at base, very much compressed, its surfaces rather sparsely covered with tubercles, on one side arranged in transverse broken lines, much as in *O. Milleri*, on the other side somewhat irregularly scattered.

In 1866 I described in the second volume of the Geological Survey of Illinois (p. 117, Pl. XII., fig. 3), a small broadly triangular spine covered with scattered tubercles and having the general character of *Oracanthus*, to which I gave the name of *O. pnigeus*. This was from the Keokuk limestone. Similar spines which occur in the Carboniferous limestone of Ohio I had previously described in the Bulletin of the National Institute, 1857, under the names of *O. fragilis*, *O. granulatus*, *O. abbreviatus* and *O. multiseriatus*.

In 1875 Mr. Orestes St. John took my *Oracanthus pnigeus* as the type of a new genus to which he gave the name of *Pnigecanthus* (Geology of Illinois, Vol. VI., p. 480), giving to the type species the name of *P. deltoides*. Later he added another

species, which he called *P. trigonalis* and described and figured it in the Report of the Geological Survey of Illinois (Vol. VII., p. 259, Pl. XXIV., fig. 4). The considerations which influenced him in separating these spines from *Oracanthus* are not very plain, since they have so much the form, structure and ornamentation of that genus. However, nothing positive can be said for or against the separation until more and better specimens shall afford means of comparison. The distinction which he suggests on page 479, Volume VI., viz., that the spines of *Prigeacanthus* are more like dermal scutes than dorsal spines is also true of some specimens of *Oracanthus Milleri*, as shown from the plates and text of Mr. J. W. Davis' description of that species.

In volume VI. of the Report of the Geological Survey of Illinois (pp. 477, 478) Mr. St. John describes two additional species of *Oracanthus*, viz., *O. ? obliquus* and *O. consimilis*. The specimens on which the descriptions are based are only fragments, and later (Vol. VII., p. 255) he unites *O. consimilis* with *O. vetustus* of Leidy. In this last mentioned volume (p. 257) he describes and figures (Pl. XXV., fig. 3) still another species of *Oracanthus*, which he calls *O. rectus*. The specimen is but a fragment and hardly affords material for comparison, but it comes from the Chester limestone and may very well be distinct.

In the same volume, (Pl. XXIV.) is figured a spine of *Oracanthus* that before the discovery of that which forms the subject of this memoir would have been regarded as a splendid one, inasmuch as it shows the termination and the ornamentation much more distinctly than any before known. This he regards as identical with Leidy's *O. vetustus* which is perhaps true, as that is probably a very variable species, and yet the question may be open to doubt, the ornamentation is so different in character and arrangement.

A spine of *Oracanthus* has recently been sent to me for examination by Mr. William F. E. Gurley, of Danville, Ill., which throws a flood of light on the structure of the spines of this genus and shows that we have had a very imperfect idea of their real nature. This is so well shown in the present figure, Pl. I., fig. 3, that no lengthy description is needed. It is practically complete, only a small portion of the tip being wanting, and it shows, what has been before unknown, the entire base of the spine which was buried in the integument. This is nearly as long as the exposed portion and is an elongated arch or half tube of bone which must have served as a firm support to resist all strains upon the spine from the front backward. The ornamented portion is below thickly crowded with relatively large

tubercles which are beautifully sculptured and are, toward the front edge, arranged in curved lines parallel with that edge. Above they are more sparsely set and, as so often seen in the genus, are arranged in oblique lines passing downward from the front edge, then running transversely and again curving downward. In all probability this is specifically identical with the specimen before alluded to, from the St. Louis limestone, figured by St. John and Worthen and regarded as the same with Leidy's *O. vetustus*. That specimen was obtained from the St. Louis limestone, at St. Louis, and is now in the museum of Washington University. Mr. Gurley's splendid spine is from the Kinderhook group. It is quite symmetrical, was unquestionably set on the middle line of the back and has not been much compressed.

The exposed portion is seven inches in vertical height and was once perhaps half an inch higher. The base is ten inches long, measured from front to rear, and beneath the ornamented portion shows a smooth and slightly incurved band which is so frequently seen in spines of *Oracanthus* which show the base. The shortness of this buried portion has been a puzzle, since it seemed to prove that the spines were set in the integument of the surface to a very shallow depth and therefore could have had little firmness. But the specimen now before us shows that, on the contrary, by the anterior projection of the base, the spine was prepared to endure a greater strain coming from the front than any other of which we have knowledge.

Considering the difference of form and ornamentation between this spine and Leidy's type I should have promptly decided that they represent different species, but Mr. Gurley sends me another specimen from the Kinderhook group which is certainly not distinct from the large one we have been considering and yet is as much compressed as the type of Dr. Leidy's species. The ornamentation is much more crowded than in the type specimen, and, like that on the spine already described, has a far more distinct arrangement in vertical lines, but the ornamentation in this genus is peculiarly variable, as may be seen in the specimens described by Agassiz and Davis. Possibly the accumulation of more material will show that these spines from the Kinderhook group are specifically different from that described by Dr. Leidy, but in the absence of any positive diagnostic features I have hesitated to separate them.

ORACANTHUS PUGIUNCULUS, St. J. & W.

Pl. XXII., fig. 4.

Oracanthus pugiunculus, St. J. & W., Palæontology of Illinois, Vol. VI., p. 430, pl. 21, figs. 9-9c.

This peculiar spine has heretofore been known only by Mr. St. John's figure and description cited above. Unfortunately the type specimen was so embedded in the rock as to expose only the posterior face. An enlarged view is given in figure 9 c of a portion of the anterior surface which shows numerous parallel costæ surmounted by tubercles separated by intervals of four or five times their diameter. This is the normal surface of *Oracanthus* and yet it does not tell the whole story in regard to this species.

Recently I have received a specimen from the St. Louis limestone of Alton, Ill., collected by Mr. William McAdams, which is almost the counterpart of that described by Mr. St. John, except that it shows the anterior face from near the base to the summit. The ornamentation of this surface exhibits some remarkable characters; below it is like that in the figure cited above, but from the middle of the spine upward the longitudinal costæ become almost obsolete and the surface is occupied by rows of relatively large rounded button-like tubercles somewhat scattered where they first appear, but closely approximated above. A fragment of the upper part of the spine seen by itself would never be referred to *Oracanthus*, but would be regarded as a portion of a spine of *Xystriacanthus*, *Drepanacanthus* or *Asteroptychius*, all of which have somewhat similar ornamentation.

There is little doubt that these small, straight, nearly cylindrical spines with this compound ornamentation will, when other specimens shall be procured that will show the base—wanting in the two now known—be assigned a separate genus.

ORACANTHUS LINEATUS, n. sp.

Pl. XXII., fig. 5.

Spine three and a-half inches in length, broadly conical in form, originally transversely thick, now much compressed, summit abruptly brought to an acute point, sides set with relatively large, conical, obtuse, striated tubercles arranged in vertical rows; on the anterior margin these tubercles are higher and in part acute, posterior margin formed by two smooth or striated edges which originally bordered a pulp cavity that reached nearly to the summit. One of the sides reaches back much further from the anterior margin than the other and it is evident the spine was never symmetrical, was not set on the dorsal line, but was sunk obliquely into the integument somewhere on the side like the modified scales, the spinous scutes of *Gasterosteus*, *Climatius*, *Diplacanthus*, etc.

The spine which is the basis of the foregoing description belongs to the group which Mr. St. John has associated in his genus *Pnigeacanthus*, but which in my judgment represents only the body spines of the sharks of which the typical *Oracanthus* was the dorsal spine. These abnormal spines are triangular in outline, frequently thin shells, compressed flat in fossilization. In this group we have *Oracanthus pnigeus* N. & W., from the Keokuk limestone, *O. abbreviatus* N., from the Devonian limestone of Ohio and Mr. J. W. Davis has figured several such as forms of *Oracanthus Milleri* in his "Fossil Fishes of the Carboniferous Limestone Series of Great Britain." From the great variety of forms assumed by these defenses in *O. Milleri*, it is evident that they were not all fin-spines, but that some of them were scutes somewhat like those of the sturgeon. A part of them, however, viz.: such as that now described, and those figured by Mr. Davis in the work cited above, Pl. LXII., figs. 3, 7, were probably fin-spines, but not from the back. They are all conical, comparatively short, have a deep sulcus behind, which reaches nearly to the summit, and are unsymmetrical. Hence I infer that they are the defenses of the ventral fins, like the short spines of *Stethacanthus* described in this paper. They might be thought to be pectoral spines like the large and normal spines of *Stethacanthus*, with which I have found the fin preserved in place, but they are not large enough. *Oracanthus Milleri* was a large fish of which the dorsal spines were sometimes nearly two feet in length, and if the pectoral fins were provided with spines they must have been much larger than those under consideration.

CTENACANTHUS GURLEYI, n. sp.

(Of this species no figure has been given.—*Ed.*)

Spine of large size, ten to twelve inches in length by three to four inches in breadth at the base of the ornamented portion; section compressed, greatest thickness little more than an inch, enameled surface entirely occupied by longitudinal ridges which are of nearly uniform breadth and closely pectinated.

Up to the present time we have only fragmentary specimens of these great spines. They are manifestly distinct from any species hitherto described and are distinguished above all by their large size, great breadth, flattened sides and numerous subequal, closely pectinated costæ. The unornamented portion is remarkably smooth, but its form and dimensions are not shown in the specimens before us. The posterior surface above the opening is flattened with a strong, central, rounded keel.

Formation and locality, St. Louis Beds, Salem, Indiana. Types in the cabinet of Mr. Gurley.

CTENACANTHUS DEPRESSUS, n. sp.

Pl. XXII., fig. 6.

Spines eight inches or more in length by one inch in breadth, moderately compressed, gently curved backward, posterior face flattened, sides marked with about thirty longitudinal ridges, simple except just at the base where they are forked, subequal except near the posterior margin where they are finer; base smooth or longitudinally striated, line of demarcation between base and ornamented portion extremely oblique, the plain surface reaching to the upper third of the length of the spine. This shows that the spine was set in the back at a very low angle and, as a necessary consequence, the posterior opening reaches to and beyond the middle. The tuberculation of the ornamented surface is inconspicuous; along the anterior border the ridges are set with closely approximated simple and plain tubercles; on the sides the longitudinal ribs are nearly or quite smooth.

The nearest approach to this spine in form and structure among described species is perhaps *Ctenacanthus Buttersi*, St. J. & W. (Report of the Geol. Surv., of Ill., Vol. VII., p. 240, Pl. XXII., fig. 2), but it is very much larger than that species, occurs at a different horizon and shows nothing of the curvature of the ribs as they approach the smooth base. Hence it is specifically quite distinct, but the general form of the two species must have been similar and they were alike in being inclined at a very low angle so that the line of insertion runs far up toward the point.

Formation and locality, Kinderhook group, Le Grande, Iowa. Type in the cabinet of Mr. William F. E. Gurley, Danville, Ill.

STETHACANTHUS PRODUCTUS, n. sp.

Pl. XXIII., figs. 1-2.

Pectoral spines of large size, eight inches or more in length by two and one-half inches in breadth at base and one and a-quarter inches in thickness, dorsal margin gently curved, dorsal tuberosity relatively low and narrow, section near summit triangular.

Several large spines of *Stethacanthus* are contained in the collection of Mr. Gurley. They are, as is so common in the spines of this genus, quite imperfect and yet enough is shown of their form to indicate that they are distinct from the allied large species, *S. altonensis* and *S. tumidus*. From the former species

they may be distinguished by being more narrow, less curved and having the summit prolonged into a relatively slender and acute point. In *S. tumidus* the spine is broader and more curved and the dorsal prominence is more elevated and were perfectly bilobed. From the smaller spines of *Stethacanthus* found in the same beds and described in this paper (*S. compressus*) these may be distinguished by their much greater size, lesser curvature, greater relative thickness and different form of the dorsal prominence.

In the same beds with the spines of *Stethacanthus productus* are found certain anomalous fin-spines, which are at first sight very different from *Stethacanthus*, and yet while different in form they are composed of the same peculiar osseous material and have the same smooth, unornamented surface, show the same want of symmetry and have a similar cleft or sulcus along the back. They are about four inches long by one inch or more in width, robust, straight, triangular in outline with the base sloping backward. The cleft along the posterior margin is similar to that of several species of *Stethacanthus* and reaches quite to the summit, which is obtuse. The margins which border the posterior fissure are of unequal width, making the spines unsymmetrical and showing that they were not set on the median line. As I have shown, all the spines of *Stethacanthus* hitherto described were attached to the pectoral fins, the bases of which were inserted in its posterior clefts. In like manner, as it seems to me, the short, straight spines I have described were connected with the other paired fins, the ventrals. It is scarcely probable that we shall ever find in the Burlington limestone the complete fins of *Stethacanthus*, as we have done in the Waverley shales of Ohio, and so will always want the demonstration which the Ohio specimens furnished, and yet the structure of these short, straight spines is so entirely what it would have been if the ventral fins of *Stethacanthus* had been provided with spines, that I think we may fairly infer that such was their character.

Formation and locality, Burlington limestone, Burlington, Iowa. Type in the cabinet of Mr. W. F. E. Gurley, of Danville, Illinois.

STETHACANTHUS COMPRESSUS, n. sp.

Pl. XXIII., figs. 3-4.

Pectoral spines of small size, three to five inches long, one inch wide at base, very much compressed, extremity long, pointed, dorsal prominence relatively large, rising at a high angle, oval, flattened, with acute edges. Beneath this prominence the spine is compressed to an acute edge.

These small spines are somewhat different in form from any of the group to which they belong, being relatively broader toward the base and more slender and acute at the summit, while the body is much compressed. The dorsal prominence is peculiar in its breadth and acute edges. These spines are all quite unsymmetrical, the thin margin which borders the posterior sulcus being much broader on one side than on the other. In size and general form they are not unlike those figured by St. John and Worthen in Vol. VI. of the Geological Survey of Illinois, Pl. 18, figs. 7, 8 a and which are erroneously referred to *Physonemus gigas*, N. & W. The spines before us are, however, more compressed than those referred to, are broader at the base and the dorsal prominence is more flattened. By comparing the figures now given with those contained in the volume cited, it will be seen that the differences from any form there described are such as to require them to be regarded as forming a distinct species.

In my notes on *Stethacanthus* contained in Monograph XVI. of the U. S. Geol. Survey, I have shown that all the spines similar to *Physonemus altonensis*, St. J. & W., are generically distinct from *Physonemus*, that the surface was never ornamented with tubercles and that they were certainly spines of the pectoral fins. Both the latter points are proven by the discovery of two spines in the fine argillaceous shale with the fins still attached and the surfaces perfectly smooth.

Formation and locality, Burlington limestone, Burlington, Iowa. Type specimen in the cabinet of Mr. W. F. E. Gurley, Danville, Ill.

ASTEROPTYCHIUS GRACILIS, Newb.

(No figure of this species has been found.—*Ed.*)

Spines of small size, straight and extremely slender, about four inches long by one-fifth inch in breadth at base; buried portion relatively long (one inch in the type specimen) conical in form, regularly and finely striated throughout; ornamented portion nearly circular in section, traversed by a few strong, polished ridges, 4 or 5 at base, 2 near summit, separated by striated, depressed bands. On the anterior margin near the base are set several conical tubercles. The posterior face carries two rows of relatively large, conical, subacute denticles which are turned upward, unless at the tip, which is wanting in the type specimen.

This slender and distinctly marked spine is most like *Asteroptychius St. Ludovici*, St. J. & W., described in Vol. VI. of the Report of the Geological Survey of Illinois, p. 437, Pl. 16, figs. 3 a to 4 g, but it is less curved, more slender, less compressed, has

fewer costæ and tubercles and the denticles of the posterior face are more remote and more generally turned upward. It is from the same horizon, but is a very distinct species.

Formation and locality, St. Louis limestone, Alton, Illinois. Collected by Mr. Wm. McAdams.

GENUS DACTYLODUS, N. & W.

In 1866 this genus was defined in the Report of the Geological Survey of Illinois, Vol. II., p. 33. It was based upon a Petalodont tooth nearly two inches in length and one and a-half in width, of which the crown had the general form of that of *Petalodus*, but was quite obtuse, was without the enameled folds at the anterior base and the root instead of being spatulate or tongue-shaped as in *Petalodus* was divided into a number of well-defined rootlets. This tooth was called *Dactylodus princeps*. Two other species of this genus were also described (*D. lobatus* and *D. inflexus*), one from the St. Louis limestone and another from the Chester beds having the same general character as *D. princeps*, but much smaller. Subsequently Mr. Orestes St. John described in Vol. VI. of the Geological Report of Illinois three other species, *D. excavatus*, *D. concavus* and *D. minimus*, all small, two from the St. Louis limestone at Alton and one from the Chester limestone.

In 1888 Mr. A. von Inostranzeff described and figured in the "Travaux de la Société des Naturalistes de St. Pétersbourg, Vol. XIX.," another species of *Dactylodus* from the Mountain Limestone of Moscow which he calls *D. Rossicus*. Meantime (1883), Mr. J. W. Davis had published his paper on "The Fossil Fishes of the Carboniferous Limestone Series of Great Britain," in which he gives figures of a species of *Dactylodus* which he calls *Polyrhizodus coleï* and he considers *Dactylodus* but a variety of *Polyrhizodus*. The same view is taken in "The Catalogue of British Fossil Vertebrata" by Arthur Smith Woodward and Charles Davies Sherborn, London, January, 1890, where, on p. 158, *Dactylodus*, N. & W. is described as a synonym of *Polyrhizodus*. From this decision I venture to appeal. The species upon which the genus *Polyrhizodus* was founded by McCoy, *P. magnus* [Ann. Mag. Nat. Hist. (2), Vol. II., p. 126], has low, broad, arched, obtuse and triturating teeth without cutting edge in which the root is divided into a large number of small radicals; whereas the teeth of which *Dactylodus princeps* may be considered as the type are much more nearly like those of *Petalodus*, differing from them in having the edge of the crown less acute and wanting the folds of enamel along the anterior base.

The affinity of these teeth to *Petalodus* is also shown by one of Mr. Davis' figures of *Petalodus acuminatus*, Ag. in the work cited above, Pl. LIX., in which the root is divided like that of *Dactylodus*. We must look for the counterpart of McCoy's *Polyrhizodus magnus* in such teeth as *P. borosus*, N. & W. (Report of Geological Survey of Illinois; Vol. II., p. 49, Pl. 3, fig. 9), and in the multitude of broad, low, many rooted teeth such as *P. dentatus* and *P. ponticulus*, N., *P. Littoni*, *P. arcuatus* and *P. carbonarius*, St. J. & W. There are certainly resemblances among all these teeth, for they are members of one family, the Petalodontidæ, but the group to which we have given the name *Dactylodus* and of which so many fine examples are now shown well deserves to be distinguished by a special generic name.

DACTYLODUS PRINCEPS, N. & W.

Pl. XXIII., figs. 5, 5 a, 6 (? Ed.).

In 1888 a figure and description of a very complete, but then unique tooth was given in Vol. II. of the Report of the Geological Survey of Illinois (p. 45, Pl. 3, figs. 6, 6 a, 6 b) to which the name *Dactylodus princeps* was given, and it was made the type of the genus. Since then a large number of similar teeth have come into my possession which enable me to give a somewhat more detailed description of the species than has been hitherto possible. The specimen which was made the type is a little larger than the average and yet it represents the species well but some old and much worn teeth which I refer to it are more massive. The variation in the many teeth which I have is interesting, but they are alike in this that they are all unsymmetrical, as is the type specimen, they have the anterior face strongly arched in both directions and there is no ridge or enamel fold at its base; the upper margin is generally quite obtuse and, except just along the abraded edge, the anterior face is black. The posterior face is light gray, the enameled band quite strong and usually gently arched, without a sinus.

An unusually symmetrical tooth from the St. Louis beds at Greencastle, Indiana, exhibits an interesting feature in a broad and deep cavity worn at the base of the posterior face of the crown by the opposing tooth. This is a character that would doubtless appear in the teeth of this species more frequently, if the tenacious matrix were removed from their posterior faces.

All my specimens are from the St. Louis limestone and most of them were collected by Mr. William McAdams at Alton, Ill. (These specimens are now in the collection of Columbia University. Ed.).

DACTYLODUS LATUS, n. sp.

Pl. XXIII., figs. 7-7 a.

Teeth broad, relatively light and thin; crown from one and a-half to two inches broad, one and a-quarter inches high on the posterior face, three-quarters of an inch on the anterior; roots about four in number, relatively short, enamel folds of posterior face distinct, forming a broad sinus in the middle and connecting with a less distinctly marked but continuous elevated band at the base of the anterior face, which also forms a deep sinus in the middle; anterior face of crown light in color, smooth, gently arched laterally, straight vertically; posterior face straight laterally, slightly concave vertically; superior margin subacute.

The teeth which form this group are well represented in the accompanying figures. Their most distinctive features are their great relative breadth and lightness, the vertically straight, smooth, light colored anterior face of crown, the sinuses of the enameled ridges before and behind. In general form and proportions they most resemble the tooth (*D. lobatus*, N. & W.,) described in Vol. II. of the Report of the Geological Survey of Illinois, p. 47, Pl. 3, fig. 7, but they are very much larger and have the sinuses of the enameled bands more pronounced. It is quite possible, however, that they may be only the mature teeth of the same species. The accumulation of more material will alone decide that question.

Formation and locality, St. Louis limestone, Alton Ill., Type specimen in the cabinet of Columbia University.

DACTYLODUS RECTUS, n. sp.

Pl. XXIII., figs. 8, 9.

Teeth of medium or small size, mostly about one inch in breadth by three-fourths of an inch in height; crown broad and low, anterior surface nearly flat, inclined to the perpendicular at an angle of about 45° , black and highly polished, terminating below in a broad, cupid's-bow, subacute margin without enamel folds; root relatively short and broad, composed of four to seven rootlets; posterior face transversely elliptical with acute ends, vertically slightly concave, horizontally nearly straight, enamel folds at base prominent, forming a simple curve without sinus.

The above description is based upon a number of teeth of nearly the same size and having somewhat special characters in their broad form, flat, highly polished crown without enamel folds on the anterior face. The posterior face is nearly plane,

vertically and laterally. One larger tooth in my collection shares these characters except that the root is relatively longer and I am inclined to think it is an old and worn specimen, but the discovery of others may possibly show that it is only mature. All these teeth differ from those of *D. princeps* in being broader and lighter, the crown lower and flatter; the anterior face of the crown in *D. princeps* being strongly arched laterally and sometimes vertically.

In form these teeth resemble most those of *D. inflexus*, N. & W. from the Chester limestone, but in that species the anterior face of the crown is almost at right angles with the vertical, presenting a flat top by which the summit of the tooth is much thickened.

Formation and locality, St. Louis limestone, Alton, Ill. Type specimens in the cabinet of the Columbia University.

DELTODUS GRANDIS, N. & W.

In the second volume of the Report of the Illinois Geological Survey (p. 101) was described a large Cochliodont tooth, to which the above name was given. In the seventh volume of the Report (p. 186) Messrs. St. John and Worthen, referring to *Sandalodus lævissimus*, unite with it *S. grandis*, N. & W. Against this view I have no facts to offer, and cheerfully concede that the large amount of new material in the possession of Messrs. St. John and Worthen made them better judges in 1883 than we were in 1866 as to the relations of these closely allied, if not identical species, but I must protest against the union of *Deltodus grandis* with them. Within the last twenty years I have obtained a large number of teeth which are certainly identical with that named by Mr. Worthen and myself, *D. grandis*. In the light of that material it is impossible for me to accept the view that this species should be united with *Sandalodus*. The teeth we have called *Deltodus grandis* are, in my judgment, typical representatives of the genus, and if it should be proved that they were once associated with such teeth as those named *Sandalodus lævissimus*, then the genus *Sandalodus* must be abandoned. Yet the proposed union of the two genera seems to me highly improbable from the fact that in many localities and formations the teeth called *Deltodus* are not uncommon, while no straight teeth, like the type species of *Sandalodus*, are present. Nothing but the evidence of these diverse forms of teeth found in apposition and plainly the parts of one dentition could persuade me that they are not generically different. Messrs. St. John and Worthen had no such proof, on the con-

trary, as appears on p. 187 (*op. cit.*), the union is made upon no better ground than a suspicion.

In regard to the union of *Sandalodus grandis*, N. & W., with *Cochliodus? crassus*, N. & W., *Psammodus? semicylindricus*, N. & W., and *P.? rhomboideus*, N. & W., they say, "these names were applied to abnormally worn and otherwise imperfect examples of the maxillary posterior form (tooth?) of this species." This statement I am quite unable to accept. That such a tooth as that represented by figure 9, Plate X., Vol. II., Geological Survey of Illinois, could ever be worn or distorted into such forms as figures 4, 5 and 6 of Plate XI. (*op. cit.*) seems to me quite impossible. The teeth represented by the latter figures were placed in *Psammodus* only provisionally and with a query. I shall be very glad when, in the light of new material, they may be referred to their proper genera, but I cannot say that I think it has yet been done.

DELTODUS INORNATUS, n. sp.

Pl. XXIII., figs. 10-11.

Maxillary posterior tooth long-triangular in outline, four inches long by one and a-half inches wide, strongly twisted, surface smooth, without angles or traversed folds; posterior margin rounded; mandibular posterior tooth similar to that of the upper jaw in general character, but shorter and broader, two and three-quarter inches in length, by one and three-quarter inches wide. The tooth is thick and ponderous, its surfaces plain, its angles rounded.

These teeth are nearly of the size and form of those of *Deltodus grandis* N. & W., but are distinguishable at a glance by their smooth surfaces and rounded outlines; the crown enamel is punctate as usual, but there are no longitudinal or transverse bands or ridges and the whole aspect is exceedingly modest and plain.

Formation and locality, Kinderhook group, Le Grande, Iowa. Type in the collection of William F. E. Gurley, Danville, Ill.

DELTODUS COMPLANATUS, N. & W.

Pl. XXIV., figs. 1-7.

In Vol. II. of the Illinois Geological Survey, p. 98, Pl. IX., fig. 4 is published a description of a tooth to which this name was given. It was somewhat imperfect and had been crushed and flattened. This was from the Burlington limestone, and in the same volume (p. 112, Pl. XI., figs. 8-9) were described and

figured two teeth from this formation, having triangular outlines and different forms of crown from any before known. To these the generic name *Trigonodus* was given. Subsequently Mr. Orestes St. John, having access to the magnificent collections of fish teeth belonging to Mr. Van Horne, Mr. Wachsmuth and Mr. Springer, was able to bring into their relations many of the scattered teeth of the Lower Carboniferous limestone and reconstruct the dentition of the ancient sharks much more completely than had been before possible.

Referring to *Deltodus complanatus*, in Vol. VII. of the Report of the Geological Survey of Illinois, p. 184, he calls it a *Sandalodus* and unites with it *Trigonodus major*. The latter union is doubtless well founded, but I am unable to accept his views in regard to the generic relations of the species to which both forms of teeth belong. I have recently received from Mr. W. F. E. Gurley, of Danville, Ill., a large collection of the remains of Elasmobranch fishes. Among these are many teeth of *Deltodus complanatus* which prove beyond question that this should be considered a *Deltodus* and not a *Sandalodus*. In order that some of this evidence shall be judged by others I publish herewith a number of figures photographed from specimens in Mr. Gurley's collection. I think it will be agreed by all that they represent teeth of *Deltodus* and not *Sandalodus*. Indeed among all the fish teeth from the Burlington limestone which I have yet seen I have not detected a tooth of *Sandalodus*.

DELTODUS SPATULATUS, N. & W.

Pl. XXIV., figs. 8-11.

(Among the specimens in the Gurley collection were a number of well preserved dental plates which Dr. Newberry referred to *Deltodus spatulatus* (Burlington group). (N. & W., 1866, Geol. Survey of Illinois, Vol. II., p. 100.) A number of figures of these plates were prepared for publication in the present paper; but the editor can find none of Dr. Newberry's notes relating to them. He has accordingly selected but four of these figures for comparison with *D. complanatus*. They may at the same time serve to illustrate the author's views regarding the variational characters of this species.—*Ed.*)

SANDALODUS ELLIPTICUS, n. sp.

Pl. XXIV., fig. 12.

Terminal tooth long-elliptical in outline, one and three-quarter inches long by three-quarters of an inch wide, strongly arched

transversely, gently arched longitudinally, ends rounded; surface without folds, uniformly and finely punctate.

The generic relations of these teeth are somewhat obscure, but they approach most nearly those described in the 4th volume of the Geological Report of Illinois, p. 369, Pl IV., fig. 3, with the name *Sandalodus crassus*; the teeth of that species are, however, longer, narrower at the anterior extremity and less symmetrically arched behind. Among a large number of teeth of *Sandalodus crassus* recently received from Mr. William McAdams, Alton, Ill., are some which are quite complete, and these show a prominent point extended from the straight side beyond the crown surface, a feature which does not appear in the figure cited. Probably such a point or angle projected from the posterior end of the teeth before us, so that the general outline was less elliptical than that of the crown surface.

Mr. Orestes St. John has transferred *Sandalodus crassus* to his genus *Orthopleurodus*, perhaps with reason, though it is separated somewhat widely from *O. carbonarius* of the Coal Measures. The teeth under consideration could not follow *Sandalodus crassus* into *Orthopleurodus*, as the anterior extremity is broader and rounder and neither side is straight.

With the nearly complete tooth now figured is a fragment of another which was apparently about the same size and shape and is evidently the corresponding tooth from the other side of the mouth. Taken by itself this fragment might readily be mistaken for the posterior extremity of a tooth of average size of *Sandalodus crassus*, but the anterior portion is wanting. If the more complete tooth has suffered no injury, its rounded extremity separates it widely from all species of *Sandalodus* and brings it nearer in form to the tooth which I obtained from the Keokuk group in central Kentucky and described in Vol. II. of the Paleontology of Ohio, p. 38, and named *Platyodus lineatus*. Since then Mr. St. John has described, in Vol. VII. of the Report of the Geological Survey of Illinois, p. 82, a large though imperfect tooth from the Kinderhook group, which may have had somewhat the form of those now under consideration, and is, perhaps, referable to the same genus. This tooth he has called *Vaticinodus vetustus*. Unfortunately all the anterior portion of the tooth is lacking, and therefore satisfactory comparisons cannot be made. All these teeth have a general resemblance in their oblong or elliptical outline and low arched crown to the tooth of *Platyodus* referred to above, and yet the linear punctation of that tooth indicates differences that are probably generic.

With more material it may be necessary to give the teeth now described a new generic name, but without such material it would

hardly be possible to give the full and accurate generic definitions which are desirable to avoid adding to the great mass of synonymy in Paleontology.

Formation and locality, Kinderhook group, Le Grand, Iowa. Type in the cabinet of Mr. William F. E. Gurley.

PSEPHODUS (HELODUS) POLITUS, n. sp.

Pl. XXIV., figs. 13-23.

Teeth of various forms and sizes, generally oblong with rounded ends, more or less arched in both directions; root low, parallel with the crown, smooth and often polished below, one side sloping to the edge of the crown, on the other higher, vertical, strongly striated; crown highly polished, uniformly punctate, sometimes low and broadly arched in both directions, in other and narrower teeth strongly arched and rising into a rounded boss; one lateral margin of the crown projecting beyond the root and terminating in an obtuse edge, on the other side coarsely crenulated.

The smaller, narrower and more highly arched of these teeth would be accepted as typical specimens of *Helodus* which are undoubtedly the anterior teeth of various Coeliodont fishes, a good example being *Helodus nobilis*, the central teeth of *Cochliodus nobilis*, N. & W. described in Vol. II., of the Geological Survey of Illinois, p. 88, Pl. VI., both forms occurring in juxtaposition.

With these smaller teeth occur others larger, less strongly arched and in form approaching nearer to those of *Psephodus* and evidently to be classed generically with *Helodus placenta*, N. & W., from the Kinderhook group a form which Mr. St. John makes the type of his *Psephodus placenta*. But the teeth which are now figured and which are alike in the peculiar character of their *highly polished* and punctate enamel include none that have much affinity with the teeth of *Psephodus magnus*, Ag. or those of its generic associate *Psephodus crenulatus*, N. & W., from the Chester limestone of Illinois. I am, therefore, very doubtful whether they should be included in the same genus, and yet more material will be necessary before this question can be definitely settled.

Formation and locality, Burlington limestone, Burlington, Ill. Type in the cabinet of Mr. William F. E. Gurley.

HELODUS COXANUS, n. sp.

Pl. XXIV., fig. 24.

Median teeth, five or more in a linear series, increasing in size

from behind forward; crowns triangular, conical, compressed, obtuse, smooth, in anterior and largest tooth crown about half an inch long and high, two-fifths of an inch wide, teeth of first lateral series broader than high, crown four-fifths of an inch wide by half an inch high, elliptical in outline, rising into a central cone or boss, which is obtuse, smooth and, like the central series, uniformly punctate and jet black; second lateral series compressed from front to rear, one inch or more in breadth, crown bearing an obtuse cone near the interior end.

The teeth of this group apparently form symphysial rows on the jaws of some *Cochliodus* fish of which the broader lateral teeth are unknown or have not yet been connected with them. Probably the dentition was similar to that of *Cochliodus nobilis*, described and figured in Vol. II. of the Geological Report of Illinois, pp. 88, Pl. VI., VII. and VIII. Doubtless some future discovery will show the general characters of the dentition more fully and permit of the association of these central teeth with the lateral ones; until this shall be done, however, it will be necessary to designate the central teeth by a provisional name, such as is now given to them.

Formation and locality, Keokuk limestone, Keokuk, Iowa, where the fine series of teeth represented in Pl. XXIV., fig. 24, was discovered by Mr. L. A. Cox, to whom the species is dedicated. Types in the cabinet of Mr. William F. E. Gurley.

CTENODUS FLEISHERI, n. sp.

Pl. XXIV., fig. 25.

Upper palate teeth triangular in outline, concave, the crown traversed by five rows of rounded, obtuse tubercles which are traceable to the apex of the triangle. Here mere lines of dots represent the diminished tubercles.

Only one tooth of this species has yet been found and that is imperfect, but its characters are sufficiently well preserved to show that it is specifically distinct. The radiating rows of the tubercles which traverse the surface of the crown are not unlike those of *Ctenodus flabelliformis* of the Chemung, but are less crowded and the tooth is larger than any specimen of that species yet known. So too the character of the tuberculation recalls that of *Heliodus Lesleyi* from the Chemung and it is evident that during the time of the deposition of the Chemung and Catskill rocks a group of Dipnoan fishes inhabited the waters of eastern North America which were closely related one with another and yet quite distinct from any of their congeners inhabiting other parts of the world. Whatever peculiari-

ties these American Dipnoans possessed, their teeth are alike in their flattened or slightly arched form and the rounded smooth obtuse tubercles which formed rows on the crown surface.

The unique specimen upon which the above description is based was found in the Catskill formation by Mr. Daniel Fleisher, Principal of the High School at Troy, Bradford county, Pa. But a single specimen of the genus was before known in this formation, *P. arcuatus*, Newb., from Tioga county, Pa. That species, however, is much smaller and is to be distinguished from this by the ridges of the crown, which are radiately curved, while in this they are straight.

CTENODUS [SAGENODUS (*Ed.*)] ANGUSTUS, n. sp.

Pl. XXIV., fig. 26.

Right mandibular tooth one inch in length by one-fourth of an inch in width, not including the projecting points of the salient ridges. Crown surface smooth and polished throughout; radiating ridges five in number, the posterior two very short, obtuse; anterior three long-pointed, acute; surface plain or slightly waved; the anterior ridge widely divergent from the others and having a direction nearly parallel with the axis of the head.

The specimen on which the above description is based is from the Catskill rocks near Troy, Bradford county, Pennsylvania, where it was associated with *Ctenodus fleisheri*, a species from which it differs as widely as any two members of the genus. The striking features of this tooth are its narrow, elongated form and the three divergent, produced and pointed ridges of the anterior extremity. The crown surface of the whole tooth is highly polished. The ridges are rounded over without distinct tubercles, all giving it a peculiar smoothness. In this respect it resembles *Ctenodus laevis* from the Chemung, but the form is widely different. Like the species which bears his name this was collected by Mr. Daniel Fleisher, near Leroy, Bradford county, Pa.

STENOGNATHUS, n. gen.

Pl. XXIV., figs. 27-28.

Many years ago Mr. J. Terrell found in the Cleveland shale at Sheffield, Ohio, a small and imperfect jaw which is figured in U. S. Geol. Survey Monograph XVI., p. 151, Pl. VII., figs. 3 and 3 a and described under the name *Dinichthys corrugatus*. Since the publication of that volume I have received from Mr. Terrell another and much more complete jaw which shows that

the fish it belonged to, though one of the *Dinichthyidæ* could hardly have belonged to the type genus. The dentary bone, the only portion yet known, turns up at the end to form a strong tooth as in *Dinichthys* and this tooth interlocked with a sheathing premaxillary by which its extremity is much worn. In *Dinichthys*, behind the prominent anterior tooth is a second and lower one which terminates below in a ridge that crosses the inner face of the dentary bone. In the jaw before us no such tooth or internal ridge is found, and it is evident that this characteristic of *Dinichthys* is wanting. The posterior extremity of the dentary bone in *Dinichthys* is flattened and spatulate, was once buried in cartilage, and is longer than the exposed portion of the jaw. In the fossil before us, however, no such spatulate extremity has ever been present. The exposed portion of the jaw is narrowed behind and thinned to a wedge-shaped point; it was also apparently cleft vertically and thus spliced on to the cartilaginous posterior portion, the size and form of which we have no means of knowing. The figures now given of the inner and outer aspects of the jaw of *Stenognathus* will supplement the verbal description and give a clear idea of its character.

As the two left dentary bones are the only remains yet known of this fish, it is apparent we have yet much to learn in regard to its structure. Possibly other parts have been made known to the public under other names. In the same localities and strata where these jaws were found a number of highly ornamented dermal plates have been obtained by Mr. Terrell and to these I have given the name of *Glyptaspis*. It is possible that the jaws of *Stenognathus* formed parts of the same fish, but of this there is no evidence and no indication except the want of jaws for *Glyptaspis*. Other jaws, however, are found in the same formation—those described as *Mylostoma*—which have not yet been associated with any cranial bones, and these are better proportioned in size to the plates of *Glyptaspis*.

STATED MEETING.

March 22d, 1897.

The Academy met with President STEVENSON in the chair. The minutes of the last meeting were read and approved.

The following papers were read by title: "The Serpentes near New York City," by D. H. Newland. "The Trenton Strata in the Valley of Lake Champlain," by T. G. White. The publication of these papers was unavoidably postponed to a later volume.

PLATE XXII.

Illustrating posthumous paper by J. S. Newberry, entitled, "New Species and a new Genus of American Paleozoic Fishes, etc." Edited by BASHFORD DEAN. pp. 282-304.

FIG. 1. *Cladodus splendens*, n. s. Kinderhook Group, Burlington, Iowa. p. 284.

FIGS. 2, 2 a. *Cladodus mortifer*, n. s. Lower Coal Measures. near Newport, Ind. p. 285.

FIG. 3. *Oracanthus vetustus*, St. J. & W. Kinderhook Group, (Burlington, Iowa.) p. 285.

FIG. 4. *Oracanthus pugniunculus*, St. J. & W. St. Louis Limestone, Alton, Ill. p. 288.

FIG. 5. *Oracanthus lineatus*, n. s. (St. Louis Limestone ? *Ed.*) p. 289.

FIG. 6. *Ctenacanthus depressus*, n. s. Kinderhook Group, Le Grand, Ia. p. 291.

FIG. 6



NEWBERRY. PALAEOZOIC FISHES. CLADODUS, ORACANTHUS, CTENACANTHUS.

PLATE XXIII.

Illustrating posthumous paper by J. S. Newberry, entitled, "New Species and a new Genus of American Palæozoic Fishes, etc." Edited by BASHFORD DEAN. pp. 282-304.

FIGS. 1, 2. *Stethacanthus productus*, n. s. Burlington Limestone, Burlington, Ia. p. 291.

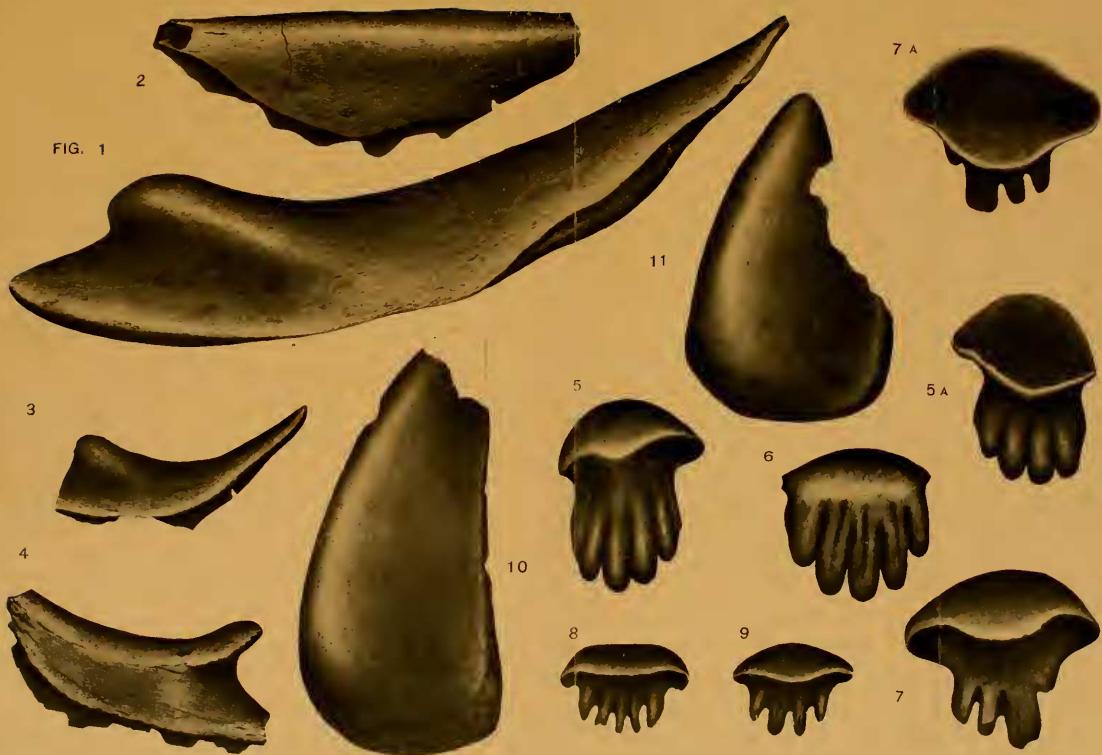
FIGS. 3, 4. *Stethacanthus compressus*, n. s. Burlington Limestone, Burlington, Ia. p. 292.

FIGS. 5, 5 a, 6 (? Ed.) *Dactylodus princeps*, N. & W. St. Louis Limestone, Alton, Ill. p. 295.

FIGS. 7, 7 a. *Dactylodus latus*, n. s. St. Louis Limestone, Alton, Ill. p. 296.

FIGS. 8, 9. *Dactylodus rectus*, n. s. St. Louis Limestone, Alton, Ill. p. 296.

FIGS. 10, 11. *Deltodus inornatus*, n. s. Kinderhook Group, Le Grand, Ia. p. 298.



NEWBERRY. PALAEOZOIC FISHES. STETHACANTHUS, DACTYLODUS, DELTODUS.

PLATE XXIV.

Illustrating posthumous paper by J. S. Newberry, entitled, "New Species and a new Genus of American Palæozoic Fishes, etc." Edited by BASHFORD DEAN. pp. 282-304.

FIGS. 1-7. *Deltodus complanatus* N. & W. (Burlington Group—*Ed.*). p. 298.

FIGS. 8-11. *Deltodus spatulatus* N. & W. (Burlington Group—*Ed.*). p. 299.

FIG. 12. *Sandalodus ellipticus* n. s. Kinderhook Group, Le Grand, Ia. p. 299.

FIGS. 13-23. *Psephodus* (*Hclodus*) *politus*, n. s. Burlington Limestone. p. 301.

FIG. 24. *Hclodus coxanus*, n. s. Keokuk Limestone, Keokuk, Ia. p. 301.

FIG. 25. *Ctenodus fleischeri*, n. s. Catskill Formation, Tioga Co., Pa. p. 302.

FIG. 26. *Ctenodus* [*Sagenodus* (*Ed.*)] *augustus*, n. s. Catskill Formation, Bradford Co., Pa. p. 303.

FIG. 27-28. *Stenognathus corrugatus*, n. g. Cleveland Shales, Lorain Co., O. p. 303.

FIG. 1

